

Original Article

Outcomes of the butler neural mobilization technique and manual therapy for chronic low back pain in patients with lumbar radiculopathy: a cross-sectional comparative study

Alishah Malik ^{a,*}, Malka Ramsha ^b, Abdul Samad ^c

^a Independent Researcher, Jeddah, Saudi Arabia

^b Gosha-e-Shifa Medical Center, Lahore, Pakistan

^c Beaumont Lodge Transitional Care Unit, Dublin, Ireland

* Correspondence: alishahmalik089@gmail.com; Telephone: +966505711631



Citation: Malik A, Ramsha M, Samad A. Outcomes of the butler neural mobilization technique and manual therapy for chronic low back pain in patients with lumbar radiculopathy: a cross-sectional comparative study. *J Basic Clin Med Sci*. 2022;1:3-11.

Received: 03 November 2022

Revised: 17 December 2022

Accepted: 23 December 2022

Published: 26 December 2022

Publisher's Note: Logixs Journals remains neutral concerning jurisdictional claims in its published subject matter, including maps and institutional affiliations.



Copyright: © 2022 The Author(s). This is an open access article distributed under the terms of the [Creative Commons Attribution \(CC BY\) License](https://creativecommons.org/licenses/by/4.0/). The use, distribution, or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

Abstract

Surgeries were considered the only effective treatment method for patients suffering from chronic low back pain with lumbar radiculopathy for a while. However, in the contemporary world, it is not regarded as the primary treatment method until other conventional pharmacological and physical therapy interventions have not proven effective. Therefore, this study compares the outcomes in terms of pain relief and perceived level of mobility in patients with chronic low back pain with lumbar radiculopathy, regardless of whether the butler neural mobilization technique or manual therapy is used. This comparative cross-sectional study was conducted in Lahore, recruiting 100 patients by rendering a purposive sampling technique undergoing any treatment method mentioned above. Observations were recorded pre- and postintervention with a follow-up of 7 days to assess the response to both techniques using a questionnaire. Face-to-face interviews were conducted to assess pain levels using the Numeric Pain Rating Scale (NPRS) and Modified Oswestry Disability Questionnaire (MODQ). Descriptive statistics, chi-square test, Mann-Whitney U test, independent t test, and the Wilcoxon signed-rank test were used to analyze the data. The medical characteristics of patients who had opted for manual therapy and butler neural mobilization were not different ($p > 0.05$), except for the quality of pain ($p < 0.05$). However, pre- and postintervention NPRS scores, pain intensity during the last 24 hours using NPRS scores, and MODQ scores were significantly different among the groups, indicating postintervention pain reduction for both groups comprising patients who had opted for manual therapy ($p = 0.001$) and butler neural mobilization technique ($p = 0.001$). Moreover, patients who had opted for either technique had improved their disability levels compared with the preintervention disability levels ($p = 0.001$). The study concluded that both techniques significantly reduce pain and disability levels, including butler neural mobilization and manual therapy, among patients suffering from chronic low back pain with lumbar radiculopathy.

Keywords

Butler neural mobilization; Manual therapy; Lower back pain; Musculoskeletal manipulations; Lumbar radiculopathy

1. Introduction

Low back pain is mechanical pain arising from the ligaments, muscles, and joints involving facet joints, sacroiliac joints, or bones in and around the vertebral column. It is characterized by soreness and discomfort, and its symptoms are often associated with muscular tightness or stiffness, resulting in limited or no movement [1]. Numerous etiologies have been linked with low back pain; lumbar radiculopathy is one of them, with

pain radiating from the low back to the buttock and leg either unilaterally or bilaterally [2]. Lumbar disc herniation, intervertebral disc pathologies, tumors, degenerative spine changes, wear and tear, and osteophyte formation are the most common risk factors for lumbar radiculopathy; they may also have an impact on nerve root inflammation, resulting in low back pain [3].

Lower back pain is experienced by 60% to 80% of individuals at any point in their lifetime [4]. Lower back pain is one of the leading global causes of disabilities associated with increased healthcare costs and healthcare facility turnover rates [5, 6, 7]. This disease triggers an annual health expenditure of US\$9.17 billion on direct medical expenditure in Australia and up to US\$105.4 billion in the United States [8, 9]. Most individuals with low back pain do not require surgical, pharmacological, or physical therapy intervention, but 10 to 20% of individuals experience severe symptoms resulting in functional limitations in daily life activities and are at risk of poor recovery [10].

The diagnosis of lower back pain with radiculopathy is based on a detailed history, orthopedic physical assessment, and neurological examination, including manual muscle testing, sensory examination, deep tendon reflexes, and motor examination [11]. Surgeries were considered the only effective treatment strategy for radiculopathy and its comorbidities [12]. However, in the contemporary world, with the advancement of medical science, surgeries are not regarded as the primary treatment strategy until the other conventional pharmacological physical therapies have not proven effective from four to eight weeks of therapy [13].

Conventional therapies for acute lower back pain owing to lumbar radiculopathy include patient education, exercise, manual therapies, and nonsteroidal anti-inflammatory drugs (NSAIDs) as first-line agents [14]. Manual therapy is a type of conservative care that involves applying several hands-on techniques, mobilization, and manipulation of the spine and extremities to examine, diagnose and treat various symptoms and diseases of the musculoskeletal system [15]. In manual therapy, Kaltenborn mobilization techniques are effective in lower back pain [16].

Butler's neural mobilization is one of the neurodynamic techniques used for the pain associated with nervous system disorders. Neurodynamic therapy (NM) is a therapeutic strategy that aims to re-establish equilibrium in and around the nervous system by mobilizing the surrounding structures. It is evident from previous studies that the neurodynamic approach alleviates central sensitization, decreases mechanical hypersensitivity to pain, revokes heightened immunological reactions, minimizes edema, and enhances fluid diffusion after nerve injury. The goal of neural tissue mobilization is to break the adhesions within neural structures and along the nerve's route at the mechanical interface down the periphery [17]. Few studies have explored the comparative response to manual therapy and butler neural mobilization. Therefore, this study compares the outcomes in terms of pain relief and perceived level of mobility in patients with chronic low back pain with lumbar radiculopathy, regardless of whether the butler neural mobilization technique or manual therapy is used.

2. Material and methods

2.1. Study design

This is a comparative cross-sectional study.

2.2. Ethics approval

The study obtained ethical approval from the Ethics Review Committee, Hussain College of Health Sciences, Lahore (No. HCHS/2022/ERC/08). The data were collected for three months between May and July 2022.

2.3. Study setting

This study was conducted in Lahore, the capital of Pakistan's most populated province, Punjab. Many public and private hospitals in Lahore provide state-of-the-art services to patients. We interviewed patients visiting public tertiary care hospitals, i.e., Services Institute of Medical Sciences (SIMS) and Jinnah Hospital, Lahore, providing care to the outpatient, inpatient, and intensive care units, with round-the-clock diagnostic and emergency services.

2.4. Participant recruitment

The study included male and female patients aged between 18 and 60 years suffering from chronic low back pain and lumbar radiculopathy. However, patients with malignancy, vertebral fracture, osteoporosis, spondylolisthesis, metabolic disease, infection, inflammation, psychological pain, cardiovascular diseases, neurological deficits, scoliosis, spinal deformities, and obesity were excluded from the study.

2.5. Sampling technique and sample size

This study employed purposive sampling, which was appropriate because the sample units were chosen based on personal judgment and convenience and met the inclusion and exclusion criteria. Therefore, the probability of any particular patient being chosen was unknown [18]. The study recruited patients with chronic low back pain and lumbar radiculopathy who were undergoing treatment. There were two treatment groups, with each group consisting of 50 patients, and one group received the butler neural mobilization technique, while the other group received manual therapy.

2.6. Study instrument development

After some modifications, a structured questionnaire with a few open-ended questions was adopted from a previous study [1]. In addition, we used the validated scales of the Numeric Pain Rating Scale (NPRS) and Modified Oswestry Disability Questionnaire (MODQ) [1, 19].

2.7. Data collection

One researcher and one physician reviewed the patient history, performed a physical examination, and evaluated appropriate radiological imaging to recruit patients for the study who met the inclusion and exclusion criteria. Before data collection, introductory leaflets were provided to patients in the local language, Urdu. These leaflets described the benefits and risks of the research, the ethics approval, and provisions to maintain confidentiality. Face-to-face interviews with the patients lasted for 10-15 minutes in local languages after obtaining written informed consent. Observations were recorded pre- and postintervention with a follow-up of 7 days to assess the response to manual therapy and butler neural mobilization techniques among patients.

2.8. Study measures

Our questionnaire comprised four sections: sociodemographic, patient history, and validated scales of the NPRS and MODQ. The sociodemographic and patient history sections consisted of 29 questions. The NPRS scale was used to evaluate the overall pain intensity and status of pain for the last 24 hours among patients using a 0- to 10-point scale with a score of 0-3 for mild pain, 4-7 for moderate pain, and 8-10 for severe pain [1]. The MODQ scale comprises ten sections with six questions, each with a score range between

0 and 5 [19]. Pre- and postintervention observations were recorded by applying manual therapy, the butler neural mobilization technique, and heat fermentation as a baseline therapy. Finally, the NPRS and MODQ scales were reused postintervention to assess pain status.

2.9. Statistical analysis

The descriptive statistics were calculated using frequencies, percentages, and measures of central tendencies. In addition, the Chi-square test, Mann-Whitney U test, independent t test, and Wilcoxon signed-rank test were used to achieve the study's objectives using Statistical Package for Social Sciences (SPSS) [version 26.00 (IBM Corp., Armonk, NY, USA)].

3. Results

Table 1 shows that most patients undergoing manual therapy (76%) and butler neural mobilization (82%) were females compared to their male counterparts (24% and 18%, respectively). Table 2 shows that patients who opted for manual therapy and butler neural mobilization had an average age of 41.58 ± 11.05 and 44.86 ± 14.12 years and education of 11.94 ± 3.29 and 11.76 ± 2.89 years, respectively. There were no significant differences in demographic indicators, including age, education, marital status, geographical location, patient occupation, and other relevant indicators, such as workload of routine work and patient's age after pain initiation, between the two treatment groups.

Table 1. Patients' sociodemographics by type of intervention applied (n = 100)

Demographics		Manual Therapy n = 50		Butler Neural Mobilization n = 50		p value *
		N	%	N	%	
Gender	Male	12	24.00	9	18.00	0.461
	Female	38	76.00	41	82.00	
Geographical location	Urban	18	36.00	15	30.00	0.523
	Rural	32	64.00	35	70.00	
Patients' occupation	Self-employed	12	24.00	11	22.00	0.558
	Employed	8	16.00	7	14.00	
	Housewife	29	58.00	28	56.00	
	Unemployed	1	2.00	4	8.00	
Marital status	Married	39	78.00	35	70.00	0.808
	Unmarried	8	16.00	10	20.00	
	Separated/Divorced	2	4.00	3	6.00	
	Widowed	1	2.00	2	4.00	

* Variables were compared using the chi-square test.

Table 2. Patients' demographic and medical indicators by type of intervention applied (n = 100)

Demographic and Medical Indicators	Manual Therapy n = 50		Butler Neural Mobilization n = 50		p value *,**
	Mean	SD	Mean	SD	
Age (in years)	41.58	11.05	44.86	14.12	0.350
Education (in years)	11.94	3.29	11.76	2.89	0.659
Duration of regular work per day (in hours)	6.68	2.17	6.50	1.90	0.814
Patient's age after pain initiation (in years)	36.94	12.20	40.96	15.00	0.076

* Age, education, and duration of regular work per day were compared using the Mann-Whitney U test. ** The patient's age after pain initiation was compared using an independent t test.

Table 3 depicts the various medical characteristics of the patients who underwent either manual therapy or butler neural mobilization for low back pain. The two treatment groups had no significant differences in most medical characteristics ($p > 0.05$). However, there was a significant difference in the quality of pain reported by the patients ($p = 0.019$), with a higher proportion of patients in the manual therapy group (56%) and butler neural mobilization group (78%) experiencing consistent pain compared to those who reported intermittent pain.

Table 3. Patients' medical characteristics by type of intervention applied (n = 100)

Medical Characteristics		Degree of Freedom	Manual Therapy n = 50		Butler Neural Mobilization n = 50		p value *
			N	%	N	%	
Duration of low back pain	Less than 7 weeks	2	7	14.00	10	20.0	0.715
	7 – 12 weeks		10	20.00	10	20.0	
	More than 12 weeks		33	66.00	30	60.0	
Pain association	Lifting	2	3	6.00	5	10.0	0.608
	Standing for a while		26	52.00	28	56.0	
	Repetitive bending		21	42.00	17	34.0	
Morning stiffness	Yes	1	41	82.00	43	86.0	0.585
	No		9	18.00	7	14.0	
Quality of pain	Intermittent	1	22	44.00	11	22.0	0.019 **
	Consistent		28	56.00	39	78.0	
Pain description	Aching	2	21	42.00	27	54.0	0.240
	Burning		8	16.00	10	20.0	
	Cramping		21	42.00	13	26.0	
Severity of pain	Mild	2	2	4.00	2	4.0	0.261
	Moderate		30	60.00	22	44.0	
	Severe		18	36.00	26	52.0	
Ways to reduce pain	Rest	2	7	14.00	16	32.0	0.057
	Medication		28	56.00	26	52.0	
	Changing position		15	30.00	8	16.0	
Reasons for worsening pain	Sitting	3	9	18.00	6	12.0	0.292
	Walking		3	6.00	9	18.0	
	Lying		2	4.00	2	4.0	
	Standing		36	72.00	33	66.0	
Back pain causes difficulty in performing regular activities	Yes	1	45	90.00	44	88.0	0.749
	No		5	10.00	6	12.0	
Overall lifestyle	Active	1	38	76.00	41	82.0	0.461
	Sedentary		12	24.00	9	18.0	

* Variables are compared using the Chi-square test. ** Significant value ($p < 0.05$).

Table 4 shows that pre- and postintervention NPRS scores, pain intensity during the last 24 hours using NPRS scores, and MODQ scores were highly statistically significant, indicating postintervention pain reduction for both groups comprising patients who had opted for manual therapy ($p = 0.001$) and butler neural mobilization technique ($p = 0.001$).

Table 5 depicts that patients who had opted for the manual therapy technique had improved their disability levels when compared with the preintervention disability levels, which was statistically significant ($p = 0.001$). Moreover, patients who had opted for the butler neural mobilization technique also improved their disability levels when com-

pared with the preintervention disability levels, which was statistically significant ($p = 0.001$).

Table 4. Comparison of pain scores among patients (n = 100)

Study Variables	Manual Therapy			Butler Neural Mobilization		
	n = 50			n = 50		
	Median	IQR	<i>p</i> value *	Median	IQR	<i>p</i> value *
NPRS Score						
Preintervention pain intensity	7.00	2.25	0.001 **	8.00	3.00	0.001 **
Postintervention pain intensity	4.00	1.00		4.00	4.00	
Preintervention pain intensity during 24 hours	7.00	2.00	0.001 **	8.00	2.25	0.001 **
Postintervention pain intensity during 24 hours	4.00	1.00		4.00	4.00	
MODQ Score						
Preintervention pain intensity	22.00	13.00	0.001 **	22.50	11.00	0.001 **
Postintervention pain intensity	10.00	8.00		11.50	7.25	

* Variables are compared using the Wilcoxon signed-rank test. ** Significant value ($p < 0.05$).

Table 5. Pre- and postintervention perceived levels of disability among patients using MODQ scores (n = 100)

Demographics	Degree of Freedom	Preintervention		Postintervention		p value *
		n = 50		n = 50		
		N	%	N	%	
Manual Therapy						
No disability	4	1	2.00	6	12.00	0.001 **
Mild disability		7	14.00	31	62.00	
Moderate disability		22	44.00	12	24.00	
Severe disability		14	28.00	1	2.00	
Completely disabled		6	12.00	6	12.00	
Butler Neural Mobilization Technique						
No disability	4	1	2.00	6	12.00	0.001 **
Mild disability		4	8.00	28	56.00	
Moderate disability		23	46.00	15	30.00	
Severe disability		19	38.00	1	2.00	
Completely disabled		3	6.00	0	0.00	

* The variables were compared using the chi-square test. ** Significant value ($p < 0.05$).

4. Discussion

Our study results showed that most patients undergoing manual therapy and butler neural mobilization were females compared to their male counterparts. There was no statistically significant difference between the medical characteristics of patients who had opted for manual therapy and the butler neural mobilization technique except for the quality of pain. Most patients reported more consistent pain than intermittent pain. Pre- and postintervention NPRS scores, pain intensity during the last 24 hours using NPRS scores, and MODQ scores were highly statistically significant, indicating postintervention pain reduction for both groups comprising patients who had opted for manual therapy and butler neural mobilization technique. Moreover, patients who had opted for the manual therapy technique and butler neural mobilization technique had improved their disability levels compared with the preintervention disability levels, which was statistically significant.

Our study's results are consistent with various studies reported by a systematic review that was carried out to determine the role of physical therapy in lower back pain

management that compared two treatment techniques [20]. Although different therapies are available for managing such pain, manual therapy was more effective in most patients than other treatment techniques. Moreover, another study supported our study results, which were conducted to determine the effectiveness of manual therapy in improving low back pain, comparing Mulligan spinal mobilization with leg movement and Shacklock neural tissue mobilization, and reported equal effectiveness of the treatment [19]. Furthermore, the randomized controlled trial results align with our results that compared the combined effects of two manual therapy techniques, spinal mobilization with leg movement and progressive inhibition of neuromuscular structures, and by applying these techniques individually in the management of lumbar radiculopathy. Combined techniques showed significantly improved outcomes among recruited patients [21].

The study's results are consistent with another study performed to compare the effectiveness of the different treatments for lower back pain and reported that manual therapy and other treatments were equally efficacious [22]. However, the treatment's effectiveness may vary based on the duration for which the techniques are applied. A study comparing time-based treatment techniques reported better outcomes for manual therapy than for the McKenzie technique after three months. However, after six months, more improvement was observed among patients with the McKenzie technique. At 12 months, both treatment techniques were effective, but no significant difference in pain reduction was observed by any specific treatment [23]. Another study compared two therapies, including spinal mobilization with leg movement (SMWLM) and progressive inhibition of neuromuscular structures (PINS), for their effectiveness in leg and lower back pain. The study highlighted that both techniques effectively reduced leg, lower back, and sciatica pain ($p = 0.001$). However, when compared alone, SMWLM was more effective in pain reduction than PINS ($p < 0.005$) [24].

Neural mobilization is also a therapeutic strategy to re-establish equilibrium in and around the nervous system by mobilizing the surrounding structures. Human studies have shown that the neural mobilization approach alleviates central sensitization in intraneural structures and decreases mechanical hypersensitivity to pain [25]. A Brazilian study evaluated the effect of neural mobilization techniques on chronic lower back pain and analyzed changes in pain. The results of the study highlighted a 70% change in the intensity of the pain ($p < 0.001$), a 25.5% improvement in lumbar mobility ($p < 0.04$), and an improvement in the hip joint angles ($p < 0.04$) [21]. However, the severity of nerve injury and how precisely a healthcare practitioner applies the therapy determine the effectiveness of neural mobilization [26, 27]. These discrepancies may also reflect various medical experts' viewpoints on the use and effectiveness of the treatment [28]. In some instances, health professionals often prefer patients' demand for lower back pain treatment, compromising the implementation of the guidelines [29]. Furthermore, the skills of the healthcare professional in performing the treatment are of pivotal importance. The literature shows that a lack of skill results in compromised implementation and failure to achieve the desired outcome [30].

The study results are inconsistent with a systematic review performed from the English database and included studies for nonspecific lower back pain to determine the effectiveness of the physical therapy treatment [31]. The McKenzie approach was found to be ineffective in easing lower back pain. However, massage therapy was slightly useful for the main reduction among patients with lower back pain. Another study compared the effectiveness of Dowling's and Mulligan's manual therapy techniques in reducing lower back pain caused by lumbar disc herniation with radiculopathy. The study's results highlighted no significant difference between the two techniques for pain caused by lower disc herniation with radiculopathy [32].

This study compared two treatment techniques for patients with chronic low back pain and lumbar radiculopathy receiving care at healthcare facilities. The study had no dropouts and successfully followed up with all recruited patients. Additionally, the findings of this study contribute to the limited body of literature on this topic, particularly in the local context. However, this study has several limitations. First, it focused solely on the patient's perspective regarding pain relief and did not assess the healthcare professionals' perspective. The study did not consider other potential treatment modalities or assess knee pain associated with lumbar radiculopathy. Therefore, we recommend that future research explore other treatment modalities to determine the reasons and advantages of adopting them for pain relief and to assess their effectiveness in treating different types of patients. These investigations will be critical for identifying this patient population's most effective treatment options.

5. Conclusions

Our study concluded that both techniques significantly decrease pain and reduce disability levels, including butler neural mobilization and manual therapy, among patients suffering from chronic low back pain with lumbar radiculopathy.

Author contributions: Conceptualization, AM, MR and AS; methodology, AM, MR and AS; software, AM and MR; validation, AM, MR, and AS; formal analysis, AM, MR and AS; investigation, AM and MR; resources, AM, MR and AS; data curation, AM, MR and AS; writing—original draft preparation, AM and MR; writing—review and editing, AS; visualization, AM and MR; supervision, AS; project administration, AM, MR and AS. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no specific grant from the public, commercial, or not-for-profit funding agencies.

Ethics statement: The study obtained ethical approval from the Ethics Review Committee, Hussain College of Health Sciences, Lahore (No. HCHS/2022/ERC/08).

Consent to participate: Informed consent was obtained from all patients included in the study.

Data availability: The data supporting this study's findings are available from the corresponding author, Alishah, upon reasonable request.

Acknowledgments: We wish to thank all participating patients, staff, and administrators at the Services Institute of Medical Sciences (SIMS) and Jinnah Hospital, Lahore, Pakistan.

Conflicts of interest: The authors declare no conflicts of interest.

References

- [1] Vijayaraj V. A comparative study between McKenzie technique and neural mobilization in chronic low back pain patients with radiculopathy. *Int J Orthop.* 2018;4(2):802-6. <https://doi.org/10.22271/ortho.2018.v4.i2l.115>
- [2] Knezevic NN, Candido KD, Vlaeyen JWS, Zundert JV, Cohen SP. Low back pain. *Lancet.* 2021;398(10294):78-92. [https://doi.org/10.1016/S0140-6736\(21\)00733-9](https://doi.org/10.1016/S0140-6736(21)00733-9)
- [3] Nafissi S, Niknam S, Hosseini SS. Electrophysiological evaluation in lumbosacral radiculopathy. *Iran J Neurol.* 2012;11(3):83-6.
- [4] ELDesoky MT, Abutaleb EE. Efficacy of neural mobilization on low back pain with S1 radiculopathy. *Int J Physiother.* 2016;3(3):362-70. <https://doi.org/10.15621/ijphy/2016/v3i3/100847>
- [5] Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S, et al. What low back pain is and why we need to pay attention. *Lancet.* 2018;391(10137):2356-67. [https://doi.org/10.1016/S0140-6736\(18\)30480-X](https://doi.org/10.1016/S0140-6736(18)30480-X)
- [6] Godfrey E, Wileman V, Holmes MG, McCracken LM, Norton S, Moss-Morris R, et al. Physical therapy informed by acceptance and commitment therapy (PACT) versus usual care physical therapy for adults with chronic low back pain: A randomized controlled trial. *J Pain.* 2020;21(1-2):71-81. <https://doi.org/10.1016/j.jpain.2019.05.012>
- [7] Dieleman JL, Baral R, Birger M, Bui AL, Bulchis A, Chapin A, et al. US spending on personal health care and public health, 1996-2013. *JAMA.* 2016;316(24):2627-46. <https://doi.org/10.1001/jama.2016.16885>
- [8] Walker BF, Muller R, Grant WD. Low back pain in Australian adults: The economic burden. *Asia Pac J Public Health.* 2003;15(2):79-87. <https://doi.org/10.1177/101053950301500202>

- [9] Parthan A, Evans CJ, Le K. Chronic low back pain: Epidemiology, economic burden and patient-reported outcomes in the USA. *Expert Rev Pharmacoecon Outcomes Res.* 2006;6(3):359-69. <https://doi.org/10.1586/14737167.6.3.359>
- [10] Foster NE, Anema JR, Cherkin D, Chou R, Cohen SP, Gross DP, et al. Prevention and treatment of low back pain: Evidence, challenges, and promising directions. *Lancet.* 2018;391(10137):2368-83. [https://doi.org/10.1016/S0140-6736\(18\)30489-6](https://doi.org/10.1016/S0140-6736(18)30489-6)
- [11] Urits I, Burshtein A, Sharma M, Testa L, Gold PA, Orhurhu V, et al. Low back pain, a comprehensive review: Pathophysiology, diagnosis, and treatment. *Curr Pain Headache Rep.* 2019;23:23. <https://doi.org/10.1007/s11916-019-0757-1>
- [12] Ambulgekar RK, Katkade SM. Lumbar disc lesion: Study of epidemiology and surgical intervention. *Int J Orthop.* 2020;6(3):425-8. <https://doi.org/10.22271/ortho.2020.v6.i3g.2233>
- [13] Traeger AC, Buchbinder R, Elshaug AG, Croft PR, Maher CG. Care for low back pain: Can health systems deliver?. *Bull World Health Organ.* 2019;97(6):423-33. <https://doi.org/10.2471/BLT.18.226050>
- [14] Stochkendahl MJ, Kjaer P, Hartvigsen J, Kongsted A, Aaboe J, Andersen M, et al. National Clinical Guidelines for non-surgical treatment of patients with recent onset low back pain or lumbar radiculopathy. *Eur Spine J.* 2018;27:60-75. <https://doi.org/10.1007/s00586-017-5099-2>
- [15] Cohen SP, Vase L, Hooten WM. Chronic pain: An update on burden, best practices, and new advances. *Lancet.* 2021;397(10289):2082-97. [https://doi.org/10.1016/S0140-6736\(21\)00393-7](https://doi.org/10.1016/S0140-6736(21)00393-7)
- [16] Ashraf B, Ahmad S, Ashraf K, Kanwal S, Ashraf S, Khan N, et al. Effectiveness of spinal mobilization with leg movement versus McKenzie back extension exercises in lumbar radiculopathy. *Pak J Med Health Sci.* 2021;15(5):1436-40. <https://doi.org/10.53350/pjmhs211551436>
- [17] Sharma SS, Sheth MS. Effect of neurodynamic mobilization on pain and function in subjects with lumbo-sacral radiculopathy. *Med Sci.* 2018;7(1):5-8. <https://doi.org/10.5455/medscience.2017.06.8664>
- [18] Hendratni A, Agustina TS, Sukmaningrum PS, Widayanti MA. Livelihood strategies of women entrepreneurs in Indonesia. *Heliyon.* 2022;8(9):e10520. <https://doi.org/10.1016/j.heliyon.2022.e10520>
- [19] Thakur A, Mahapatra RK. Effect of Mulligan spinal mobilization with leg movement and shacklock neural tissue mobilization in lumbar radiculopathy: A randomised controlled trial. *J Med Thesis.* 2015;3(2):27-30.
- [20] Moffett J, McLean S. The role of physiotherapy in the management of non-specific back pain and neck pain. *Rheumatology.* 2006;45(4):371-8. <https://doi.org/10.1093/rheumatology/kei242>
- [21] Danazumi MS, Bello B, Yakasai AM, Kaka B. Two manual therapy techniques for management of lumbar radiculopathy: A randomized clinical trial. *J Osteopath Med.* 2021;121(4):391-400. <https://doi.org/10.1515/jom-2020-0261>
- [22] Will JS, Bury DC, Miller JA. Mechanical low back pain. *Am Fam Physician.* 2018;98(7):421-8.
- [23] Namnaqani FI, Mashabi AS, Yaseen KM, Alshehri MA. The effectiveness of McKenzie method compared to manual therapy for treating chronic low back pain: A systematic review. *J Musculoskelet Neuronal Interact.* 2019;19(4):492-9.
- [24] Ramos M, Cruz CA, Laurentino MF, Ashmawi HA, Santos FM, Chacur M. Effects of neural mobilization on individuals with chronic low back pain. *BrJP.* 2020;3:205-12. <https://doi.org/10.5935/2595-0118.20200041>
- [25] Neto T, Freitas SR, Marques M, Gomes L, Andrade R, Oliveira R. Effects of lower body quadrant neural mobilization in healthy and low back pain populations: A systematic review and meta-analysis. *Musculoskelet Sci Pract.* 2017;27:14-22. <https://doi.org/10.1016/j.msksp.2016.11.014>
- [26] Shipton EA. Physical therapy approaches in the treatment of low back pain. *Pain Ther.* 2018;7:127-37. <https://doi.org/10.1007/s40122-018-0105-x>
- [27] Kurt V, Aras O, Buker N. Comparison of conservative treatment with and without neural mobilization for patients with low back pain: A prospective, randomized clinical trial. *J Back Musculoskelet Rehabil.* 2020;33(6):969-75. <https://doi.org/10.3233/BMR-181241>
- [28] Buchbinder R, Van Tulder M, Öberg B, Costa LM, Woolf A, Schoene M, et al. Low back pain: A call for action. *Lancet.* 2018;391(10137):2384-8. [https://doi.org/10.1016/S0140-6736\(18\)30488-4](https://doi.org/10.1016/S0140-6736(18)30488-4)
- [29] Almeida M, Saragiotto B, Richards B, Maher CG. Primary care management of non-specific low back pain: Key messages from recent clinical guidelines. *Med J Aust.* 2018;208(6):272-5. <https://doi.org/10.5694/mja17.01152>
- [30] Huhn K, Gilliland SJ, Black LL, Wainwright SF, Christensen N. Clinical reasoning in physical therapy: A concept analysis. *Phys Ther.* 2019;99(4):440-56. <https://doi.org/10.1093/ptj/pzy148>
- [31] Cuenca-Martínez F, Cortes-Amador S, Espí-López GV. Effectiveness of classic physical therapy proposals for chronic non-specific low back pain: A literature review. *Phys Ther Res.* 2018;21(1):16-22. <https://doi.org/10.1298/ptr.E9937>
- [32] Bello B, Danazumi MS, Kaka B. Comparative effectiveness of 2 manual therapy techniques in the management of lumbar radiculopathy: A randomized clinical trial. *J Chiropr Med.* 2019;18(4):253-60. <https://doi.org/10.1016/j.jcm.2019.10.006>